Trihydroxybenzoic Acid Analogues as a Potential Drug Formulation for Inflammatory Diseases

Haleema Irfana· Siddharth Kesarwanib, and Foram Ranjeet Madiyara

a. Department of Physical Sciences, Embry-Riddle Aeronautical University, Daytona Beach, FL 32114
b. Roseman University of Health Sciences, South Jordan, Utah 84095

Introduction

In the United States, Inflammatory Bowel Disease (IBD) is the most common reason patients are referred to gastroenterologists.2 Due to the multitude of symptoms, patients are often unaware that they suffer this condition. Because of this complexity, IBD is often difficult to diagnose.3 Symptoms vary from patient to patient and range from:

- Cramps, Abdominal Pain
- Bleeding, Diarrhoea, Constipation
- Altered Gastrointestinal Motility
- Visceral Hypersensitivity
- Post Infectious Reactivity
- Carbohydrate Malabsorption
- Intestinal Inflammation

Statistics of Patients

![IBD Incidences](image)

Fig 2. IBD Incidences from 1990-2016 Worldwide.

According to the Center for Disease Control and Prevention, three million adults in the United States are diagnosed with IBD as either Crohn’s disease or Ulcerative Colitis.4 This statistic does not include pediatric patients and has increased a million patients since 1999.5 Of these patients, most were likely born in the United States, lived in suburban areas or in poverty and are Hispanic or non-Hispanic Caucasians.6 Furthermore, three times as many women experience IBD due to menstruation.7 Although this disease is prevalent in 15% of primary care cases, pathogenesis of the disease is debated and unknown.

Traditional Treatment Disadvantages

Step-up Approach

Step 1A: Dietary restrictions or antibiotics
Step 1B: Autoinflammatory drug such as Mesalamine

Top-down Approach

Step 2: Corticosteroids* to reduce inflammatory response
Step 3: Immune modifying drugs such as Azathioprine*
Step 4: Biological therapy drugs such as Infliximab*
Step 5: Surgery

*Increase risk for rare cancers.
*Increase risk for rare lymphomas.

The drug being formulated is a plant based metabolite and less carcinogenic than the medications listed above.

Formulation

The nanoprecipitate method was utilized to form a drug polymer complex.

A. Dropwise addition
B. Constant stirring
C. Substantial Precipitate
Moderate Precipitate
No Precipitate

The drug, polymer and solvent solution was added dropwise into a vial of stabilizer and water under constant stirring.

Fig 3. Step-up and top-down approach for patients with uncontrolled IBD.8

Experimental Results

![FTIR Analysis](image)

Fig 4. FTIR Analysis of Polymer-Drug Complexes.

Melting Point Ranges

<table>
<thead>
<tr>
<th>Drug</th>
<th>Melting Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug + RS 100 + P127</td>
<td>136.4-139.7 °C</td>
</tr>
<tr>
<td>Drug + RS 100 + PVA</td>
<td>187.2-188.4 °C</td>
</tr>
<tr>
<td>RS 100</td>
<td>161-167 °C</td>
</tr>
</tbody>
</table>

Conclusions

Base on the literature, IBD impacts quality of life and does not have a medication regimen that lacks major side effects. Thus, the proposed drug polymer complex drug delivery system aims to reduce the inflammatory intestinal tissue in both Crohn’s disease and Ulcerative Colitis. The optimization of the complex with the integration of a stabilizer, polymer, and drug has been demonstrated by nanoprecipitation methodology.

Future Outlook

The future outlook for this project includes the development of a stable drug delivery system and optimizing the drug release from the polymer through the pH dissolution test, drug loading, mice studies, and drug coatings at different pH of gastrointestinal tract for a specified period of time.

References

e-\text{\textregistered}\text{\textregistered}

Acknowledgments: We thank the financial support by the Office of Undergraduate Research at Embry-Riddle Aeronautical University Ignite Grant and the Physical Sciences Department at Embry-Riddle Aeronautical University.